

1. A process for removing metal ions from wastewater, comprising:

(a) providing a carbon bed for receiving a wastewater feed containing metal ions in solution, wherein said wastewater feed contains solids sized in the range of about 0.01-1.0  $\mu\text{m}$  in an amount higher than about 50 mg/l; and

(b) providing a chemical precipitation unit operation for receiving a carbon bed product stream from said carbon bed and for removing said metal ions from solution.

10 2. The process for removing metal ions from wastewater as set forth in Claim 1, wherein said wastewater contains solids in an amount higher than about 100 mg/l.

15 3. The process for removing metal ions from wastewater as set forth in Claim 1, wherein said wastewater contains solids in an amount in the range of about 500-2000 mg/l.

20 4. The process for removing metal ions from wastewater as set forth in Claim 1, further comprising passing a wastewater feed containing hydrogen peroxide and metal ions in solution to said carbon column to reduce the concentration of said hydrogen peroxide and form a carbon bed effluent having concentration levels of hydrogen peroxide less than about 1 mg/l (1 ppm).

5. The process for removing metal ions from wastewater as set forth in Claim 4, wherein said metal ions comprise copper ions.

5 6. The process for removing metal ions from wastewater as set forth in Claim 5, wherein said wastewater contains copper ions at a level in the range of about 1-100 mg/l.

10 7. The process for removing metal ions from wastewater as set forth in Claim 5, wherein said step for providing a chemical precipitation unit operation comprises contacting metal ions in

said carbon bed product stream metal ions with an organic carbamate to precipitate said copper ions.

15 8. The process for removing metal ions from wastewater as set forth in Claim 5, wherein said step for providing a chemical precipitation unit operation comprises contacting said carbon bed product stream metal ions with dithiocarbamate to precipitate

said copper ions.

20 9. The process for removing metal ions from wastewater as set forth in Claim 5, wherein said step for providing a chemical precipitation unit operation comprises contacting said carbon bed product stream metal ions with iron sulfate ( $\text{FeSO}_4$ ) or aluminum sulfate ( $\text{Al}_2(\text{SO}_4)_3$ ) to co-precipitate said copper ions.

10. The process for removing metal ions from wastewater as set forth in Claim 5, wherein said wastewater feed comprises a byproduct polishing slurry.

11. The process for removing metal ions from wastewater as set forth in Claim 10, wherein said wastewater feed comprises a byproduct polishing slurry from the chemical mechanical polishing (CMP) of integrated circuit microchips.

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12. Apparatus for removing metal ions from wastewater, comprising:

10 (a) a carbon bed for receiving a wastewater feed containing metal ions in solution, wherein said wastewater feed contains solids sized in the range of about 0.01-1.0  $\mu\text{m}$  in an amount higher than about 100 mg/l; and

15 (b) a chemical precipitation unit operation for receiving a carbon bed product stream from said carbon bed and for removing said metal ions from solution.

13. Apparatus for removing metal ions from wastewater as set forth in Claim 12, wherein said wastewater contains solids in an amount higher than about 500 mg/l.

*Q&P 52* 14. Apparatus for removing metal ions from wastewater as set forth in Claim 12, wherein said wastewater contains hydrogen peroxide and said carbon bed product stream has concentration levels of hydrogen peroxide less than about 1 mg/l (1 ppm).

5 15. Apparatus for removing metal ions from wastewater as set forth in Claim 14, wherein wastewater comprises a byproduct polishing slurry and said metal ions comprise copper ions in said byproduct polishing slurry.

10 16. Apparatus for removing metal ions from wastewater as set forth in Claim 15, wherein said wastewater comprises a byproduct polishing slurry from the chemical mechanical polishing (CMP) of integrated circuits and said metal ions comprise copper ions at a level in the range of about 1-100 mg/l.

*15 C3* 17. Apparatus for removing metal ions from wastewater as set forth in Claim 15, wherein said chemical precipitation unit operation comprises organic chemical means for contacting said carbon bed product stream metal ions with an organic carbamate to precipitate said copper ions.

18. Apparatus for removing metal ions from wastewater as set forth in Claim 15, wherein said chemical precipitation unit operation comprises organic chemical means for contacting said

carbon bed product stream metal ions with ditriiocarbamate to precipitate said copper ions.

19. Apparatus for removing metal ions from wastewater as set forth in Claim 15, wherein said chemical precipitation unit 5 operation comprises inorganic chemical means for contacting said carbon bed product stream metal ions with iron sulfate ( $\text{FeSO}_4$ ) or aluminum sulfate ( $\text{Al}_2(\text{SO}_4)_3$ ) to co-precipitate said copper ions.

20. A process for removing copper ions in a byproduct polishing slurry wastewater from the chemical mechanical polishing (CMP) of integrated circuit microchips, comprising:

(a) providing a carbon bed for receiving a byproduct polishing slurry wastewater feed from the chemical mechanical polishing (CMP) of integrated circuits, said byproduct polishing slurry wastewater feed containing hydrogen peroxide and copper 15 ions in solution at a level in the range of about 1-100 mg/l to reduce the concentration of said hydrogen peroxide and form a carbon bed effluent product stream having concentration levels of hydrogen peroxide less than about 1 mg/l (1 ppm), wherein said byproduct polishing slurry wastewater feed further contains 20 solids sized in the range of about 0.01-1.0  $\mu\text{m}$  in an amount higher than about 500 mg/l;

(b) providing a chemical precipitation unit operation for receiving a carbon bed product stream from said carbon bed and for removing said copper ions from solution;

5 (c) passing a byproduct polishing slurry wastewater feed containing copper ions in solution from the chemical mechanical polishing (CMP) of integrated circuit microchips to said carbon column; and

10 (d) contacting copper ions in said carbon bed product stream with an organic carbamate in said chemical precipitation unit operation to precipitate said copper ions and form an environmentally clean water discharge product.

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